



Dryden Flight Research Center
Edwards, California. 93523-0273

DCP-S-030
Baseline

DRYDEN CENTERWIDE PROCEDURE

CODE S

PRESSURE VESSELS and PRESSURIZED SYSTEMS

Electronically Approved by:
Associate Director

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1.0 INTRODUCTION

1.1 Purpose

This Dryden Centerwide Procedure (DCP) establishes procedures, documentation requirements, and assigns responsibilities to implement safety controls on ground based pressure vessels and pressurized systems (PV/S).

1.2 Applicability

This DCP applies to all persons at DFRC controlled locations, including contractors, visitors, and experimenters who work with or near, inventory, install or remove, inspect, or test PV/S.

1.3 Scope

This DCP applies to all personnel and ground based PV/S at DFRC controlled sites that are not otherwise listed in 1.4 Excluded Vessels and Systems.

1.4 Excluded Vessels and Systems

Certain pressure vessels and systems are governed by other regulations and codes and, therefore, are excluded from this document. Excluded pressure equipment must be properly maintained, as directed by regulations and codes, in order to be excluded. Following is a list of excluded equipment .

1.4.1 Fire extinguishers:

- Portable
- Standpipe and hose systems
- Automatic sprinkler systems
- Fixed dry chemical
- Fixed gaseous, including Halon
- Fixed water spray and foam

1.4.2 Boilers:

- Heating Boilers
- Power Boilers

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1.4.3 Heating, ventilation, air-conditioning , and refrigeration systems

1.4.4 Rescue breathing apparatus

1.4.5 Utility systems:

- Vacuum systems that operate at a Maximum Allowable Working Pressure (MAWP) that is less 15 psia (100 kPa absolute) and less than 100 cubic feet and are not man rated.
- Air-pressure tanks, shop and instrument air systems with pressure at 150 psi or less if they are not charged from a higher pressure and contain uncontaminated air.
- Water and hydraulic systems that are pressurized at or less than 600 psi.
- “Prepackaged off the shelf” equipment when the pressure is less than 3000 psi and the system has an acceptable and documented safety record.

2.0 APPLICABLE DOCUMENTS

2.1 Authority Documents

29 CFR 1910 Subpart M: Compressed Gas and Compressed Gas Equipment.

Subpart M establishes ASME Boiler and Pressure Vessel Code Section VIII as an authority document as incorporated by reference (IBR).

49 CFR Parts 172 through 179. This is a Department of Transportation regulation that sets the requirements for shipping compressed gases and other hazardous materials.

NPD 8710.5: NASA Safety Policy for Pressure Vessels and Pressurized Systems.

This NPD establishes the requirements for the NASA wide Pressure and Pressurized Systems safety program.

NPD 1700.6A: Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems. This document outlines the inservice inspection and recertification procedures for ground-based, unfired pressure vessels and systems.

ASME Boiler and Pressure Vessel Code (latest edition). Portions of this document become authoritative by OSHA reference.

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2.2 Guideline Documents

NHB 1700.1 (V1-B) NASA Safety Policy and Requirements Document. This document contains policy and safety requirements and guidelines that define the NASA Safety Program.

CAL-OSHA, Division of Industrial Safety, Subchapters 1 & 2, Fired and Unfired Pressure Vessel Safety Orders.

Compressed Gas Association (CGA) Pamphlet CGA P-1, Safe Handling of Compressed Gases. DOE, DOT, ASME, and OSHA refer to this document.

CGA C-6, Standards for Visual Inspection of Steel Compressed Gas Cylinders. Other CGA standards for gases such as helium, nitrogen, hydrogen, acetylene, and carbon dioxide may be obtained from CGA. See <http://www.cganet.com>.

ANSI Z535.1, 2, & 3. Environmental and Facility Safety Signs. This series of Standards set requirements for design, color, and criteria for warning signs.

NPG 1441.1, Records Retention Schedule

NOTE:

See 29 CFR 1910.6 for a listing of other documents that become incorporated by reference (IBR) during certain PV/S operations.

3.0 DEFINITIONS

- 3.1 De-rated Vessel or System: a vessel or system judged unsafe, unsuitable, or unnecessary.
- 3.2 Designed Pressure: is used for the consideration taken in the design of a vessel or system and determines the strength needed for the vessel or systems and their parts.
- 3.3 Designed Temperatures: the temperatures that a vessel or system is designed to tolerate at its rated pressures.
- 3.4 High Pressure: gas pressure greater than 3000 psig or liquid pressure greater than 5000 psig.

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- 3.5 Hydrostatic Test: a test of a pressure vessel or system where gases are replaced with a liquid (usually water) and pressurized to a designated level to test the pressure integrity of the vessel or system.
- 3.6 Intermediate Pressure: gas pressure from 150 to 3000 psig or liquid pressure from 1500 to 5000 psig.
- 3.7 Low Pressure: Gas pressure less than 150 psig, or liquid pressure less than 1500 psig.
- 3.8 Maximum Allowable Working Pressure (MAWP): the maximum pressure permissible measured at the top of a vessel in its normal operating position and within its designed temperatures. MAWP must be within limits of the least value for any component and does not take into consideration corrosion or loading other than pressure.
- 3.9 Operating Pressure: the pressure of a vessel at which it normally operates measured at the top of the vessel. Operating pressure shall not exceed the maximum allowable pressure (MAP) of the vessel or its components and generally is 10% to 20 % below MAP.
- 3.10 Pneumatic or Pneumostatic Test: a test of a vessel or system using a gas which is pressurized to a designated level prescribed by applicable code. This type of test is considered more dangerous than hydrostatic testing due to the expansion nature of gases and shall not be used unless authorized by the equipment manufacturer and accomplished by a person who is knowledgeable of the testing procedures required by the vessel or system.
- 3.11 Pressure System: an assembly of components under pressure. A pressure system may include vessels, piping, valves, relief devices, pumps, gages, etc.
- 3.12 Pressure Vessel: any vessel used for the storage or handling of a gas or liquid under positive pressure.
- 3.13 Pressure Vessel or Pressurized System Certification: the process and documentation that qualifies the vessel or system to operate within its intended limits.
- 3.14 Recertification: the process by which a previously certified vessel or system qualified to continue or be returned to operation.

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- 3.15 Recertification Period: the time between rectification. This period indicates time requirement between major inspections
- 3.16 Unfired Pressure Vessels and Systems: gas, air, water, and hydraulic pressure vessels and systems at DFRC covered by Pressure Vessel and Systems (PV/S) codes or standards excluding those listed in 1.4 Excluded Vessels and Systems.
- 3.17 Vacuum System: an assembly of components under vacuum.
- 3.18 Vacuum Vessel: a vessel which has an internal pressure less than ambient.

4.0 ROLES AND RESPONSIBILITIES

4.1 Overview

The chain of responsibility for ensuring that there is a safe work environment at DFRC that follows required safety standards, regulation, codes, and guidelines starts with the Center Director and flows downward through management and supervisors. In addition, each person who works at DFRC must understand that a “condition of employment” is to observe all safety specifications applicable to the task being performed.

4.2 Center Director

The Center Director or designee will designate an individual to serve as Pressure Systems Manager for DFRC.

4.3 Directorates and Single Letter Offices

Directorates and Single Letter Offices which have PV/S within their organization will ensure that regulations, codes and guidelines pertaining to PV/S are followed.

4.4 Pressure System Manager

The Pressure System Manager is responsible for:

- Implementing the requirements of this DCP, codes, and guidelines that pertain to PV/S under DFRC control.
- Developing an inventory data base of active and inactive PV/S under DFRC control.

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- Provide forecasting and funding of PV/S inservice inspections an analysis, certification, and recertification .
- Approving PV/S designs and establishing and maintaining cognizance of all requirements and activities for PV/S inservice inspection and analysis, certification, and recertification.
- Serving as the authority for technical expertise for matters involving PV/S inservice inspection, certification, and recertification.
- Assisting organization in developing a training program for PV/S operators.
- Reviewing variance requests using supporting directives and guidelines.

4.5 Chief, Safety, Health, and Environmental Office

The Chief, Safety, Health, and Environmental Office has safety oversight for the DFRC Pressure Vessels and Pressurized System Safety Program and shall:

- Ensure there is a PV/S safety program in place at DFRC.
- Advise management on matters concerning the PV/S safety program.
- Include PV/S management in scheduled and non-scheduled safety inspections.
- Investigate incidents and accidents involving PV/S and report finding to DFRC management and agencies as required.
- Approve or disapprove PV/S variance requests that have safety implications.

4.6 Contracting Officer Technical Representatives (COTRs).

COTRs will ensure that the contractor/s they represent whose personnel work with PV/S follow this DCP and other applicable directives and guidelines regarding PV/S.

4.7 Contracting Officer (CO)

The Contracting Officer will make this DCP a contract requirement when a contractor does maintenance, installs, removes, or inspects PV/S at DFRC controlled sites.

4.8 Line Supervisors

Line Supervisors are responsible for:

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- Ensuring that persons under their supervision who operate or maintain PV/S have adequate training.
- Taking actions to immediately control any hazards caused by PV/S.
- Maintaining an inventory of active and inactive PV/S under his/her control.

4.9 Shipping and Receiving

The Shipping and Receiving contractor will:

- Ensure that invoices and labels match for gas cylinders before accepting them.
- Check the retest date on cylinders before they are accepted. If a cylinder is found to be out of date for recertification it will not be accepted.

5.0 PV/S SAFETY PROCEDURES

5.1 Hydrostatic or Pneumostatic Testing of PV/S

Hydrostatic or pneumostatic certification or recertification of PV/S, except for pressure hoses, will not be accomplished by DFRC personnel or on-site contractors. These procedures shall be accomplished by off-site contractors that specialize in such work or by the owner of the vessel as is the case with most pressure bottles and cylinders used at DFRC. Variance to this rule must be approved by the Safety Office.

5.2 On-Site Certification or Recertification

- 5.2.1 When an on-site pressurized system is certified or re-certified the contractor completing the task will provide the Pressure System Manager with a schematic of the system that identifies each component and its location. The contractor will also provide the operational parameters of the system such as contents, pressure, temperature range, and recertification schedule. The Pressure System Manager will review this

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information for completeness and will provide it to the Line Supervisor responsible for the system as well as placing it in the PV/S data base.

5.2.2 Certification, re-test, and re-certification of PV/S under DFRC control will be accomplished in accordance with NPG 1700.6A, Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems, Chapter 6, Inspection Tables.

5.3 De-rating a System

A pressurized system may be de-rated by the Pressure System Manager when the system:

- Fails to meet safety standards.
- Goes out of date for certification.
- Is no longer needed or used.
- Undergoes maintenance or modification.

5.4 Maintenance or Modification of PV/S

The Pressure System Manager will approve of any maintenance or modification of PV/S.

5.4.1 Maintenance: Maintenance on PV/S will be accomplished by authorized personnel. New or repaired pressure system components will be certified as pressure checked at the original design proof pressure and checked for leaks at MAWP before the system may be placed into service.

5.4.2 Modification: Modification to PV/S occurs when other than the repaired or duplicate replacement components are used on the system. Modifications to PV/S will be accomplished by authorized personnel. When modification occurs the system design drawing will reflect the changes. These changes will be noted by the Pressure System Manager and placed on file.

5.4.3 Lockout/tagout: Pressure systems that are off-line due to maintenance, modification, or in a de-rated state shall be locked-out or tagged-out IAW DCP-S-025, Lockout/tagout.

5.5 Welding Operations On PV/S

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Welding on pressure vessels or system components will be done by ASME certified welders and in accordance with ASME Boiler and Pressure Vessel Code which applies to all pressure vessels or systems at DFRC including low pressure. The Pressure System Manager will ensure that welds on PV/S are radiographed in accordance with the above ASME code.

5.6 Flexible Pressure Hoses

A schedule for inspection and testing of pressure hoses shall be prepared by the Pressure System Manager. Pressure hoses may be inspected and tested on-site by a qualified technician.

Flexible pressure hoses shall:

- Not be used in place of permanent piping.
- Be labeled for operating pressure.
- Tested and re-certified in accordance with 5.2.2 Retest and Recertification Schedule
- Be kept as short as possible.
- Be anchored at the hose end to prevent whipping in case of a hose to fitting failure.
- Not be bent severely.
- Not be used with incompatible gases or liquids.
- Will be replaced when showing defects.

5.7 Valves and Fittings

Valves and Fittings shall:

- Be rated above the MAWP and compatible with the internal contents.
- Have valve-stem packing nuts adjusted and locked.
- Be free of oil and organic material for oxygen systems.
- Be tested and certified in accordance with 5.2.2 Retest and Recertification Schedule.

5.8 Gages

Gages shall meet the following requirements:

- Graduated to at least 1.5 times the MAWP.

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- to
- Be compatible with the contents of the system.
 - Have shatter-proof faces, solid fronts, and blowout backs when:
 1. gage is more that 4 inches in diameter and graduated to over 200 psi;
 2. gage is less than 4 inches in diameter and graduated to over 5000 psi and;
 3. to all liquid-pressure gages more than 4 inches in diameter graduated over 2000 psi.
 - Will have, where practical, a pressure relief device with sufficient flow capacity set at less than full scale reading.
 - Gages will be re-tested and certified in accordance to required schedule when critical to the safe operation of the system. (See 5.2.2 Retest and Recertification Schedule).
 - Gages whose accuracy is not critical to the operation of the system will be marked "FOR INDICATION ONLY."

Work stations shall be so designed and positioned to keep workers from standing in front (face on) to gages, especially those that are not safety types.

5.9 Unstamped Pressure Vessels

Unstamped pressure vessel over 150 psi Maximum Operating Pressure will not be accepted. The lack of a stamp on such a vessel shall be treated as a deviation for approval. Variance to this rule must be approved by the Safety Office.

5.10 Pressure Tubing

Only seamless tubing rated for the MAP of the system will be used.

5.11 Pressure Relief Devices

Pressure relief devices:

- Must be kept operational, properly labeled, and within calibration expiration date and have enough volume to relieve the pressure of the system.
- That are activated by pressure or by anyone other than a person who is authorized to do so will be checked immediately and reset only by a person authorized to do so. In the case of an over pressure release the relief device will not be re-set until it has been determined why the pressure built up to the release point and the cause corrected.

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- Will not be set above the MAWP of the lowest rated component of the system.
- Will only be repaired or replaced by a Pressure Installer and checked by a Pressure Inspector.
- Shall NOT have a shut-off valve between it and the pressure source.
- Shall be tested and re-certified in accordance with 5.2.2 Retest and Recertification Schedule

5.12 Compressed Gas Cylinders

5.12.1 Handling gas cylinders:

- Use a three or four wheel cylinder cart when moving Standard No. 1 and larger cylinders. These cylinders are difficult to move because of their shape, smooth surface, and weight.
- The cylinder's protective valve cover shall be in place and the cylinder stored in an approved holding device when not in use.
- Gas cylinders will be secured to a approved holding device when in use and attached to a non-flammable manifold. A two chain or bar holding device is preferred. Chains must be at least 1/4 inch welded type.
- Manifold parts such as valves, tubing, fittings, gages, etc., and the contents of the cylinder must be compatible.
- When in use cylinders will have a placard to indicate remaining contents or pressure.
- Always handle a cylinder as if it were pressurized.
- Do not drop cylinders from any raised surface.
- Never attempt to lift any cylinder larger than 5 liters (water volume) by yourself.
- Do not handle oxygen cylinder with greasy, oily hands or gloves.
- Move cylinders in suitable cradles or skid boxed before lifting them with cranes, fork lifts, hoists, etc. Do not use ropes or chain slings to lift cylinders.
- Do not use gas cylinders as rollers to move equipment.
- Report leaking gas cylinder/s that contain non-hazardous gases to the Pressure System Manager (Code OM) immediately. If the leaking cylinder contains a hazardous gas report it by the 911 emergency telephone system.

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- Do not use vendor owned cylinders for purposes other than as a source of gas for which they were designed, these cylinders may be re-filled and pressurized only by the owner.

5.12.2 Gas cylinders storage:

- If gas cylinders larger than five (5) liters are shipped horizontally on wooden pallets they shall be removed from their pallets and stored upright. Cylinders larger than 5 liters shall be stored on solid, dry, and level footings outside occupied buildings and away from traffic.
- Cylinders should be shaded from the sun and protected from the elements (weather), and will be stored away from sources of heat.
- Stockpiling of gases is not authorized. A reliable delivery source should be used in order to reduce the need for stockpiling. A supply of flammable, poisons, or corrosives gases will be limited to that needed for a specific time period.
- When cylinders are stored they will be firmly attached to a wall or other suitable support to avoid falling. A two chain or bar system will be used when possible. Chains will be a minimum of 1/4 inch welded chain with safety clips.
- When in use inside public areas in buildings cylinder will be protected against tampering and will not obstruct passageways or exits.
- Cylinders will be stored with protective cap installed.
- Cylinders of non-compatible gases or liquids will be properly separated. Oxidizers will be kept 20 ft. from combustibles or flammables or be separated by a non-combustible barrier that is at least 5 ft. high with a fire rating of 30 minutes.

5.13 Hazard Identification

- 5.13.1 National Fire Protection Association (NFPA) color coded placards shall be prominently displayed to identify the hazard classification of the gases being stored in cylinder storage areas. NO SMOKING signs will be posted where appropriate.

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5.13.2 Compressed gas cylinders will be inspected by the user for condition and for proper labeling before being put into use. Labels will conform to 49 CFR 172, Subpart E, Labeling.

5.13.3 Personnel in working areas where compressed gas cylinders are in use will be made aware of the hazards the specific gases pose and the precautions needed to control or eliminate these hazards. MSDSs for each gas shall be made accessible to employees in accordance with the Hazard Communication Standard. (See DCP-S-038, Hazard Communication).

5.13.4 Toxic, flammable, corrosive, or gases that present other hazards used in a laboratory setting will be handled in accordance with requirements in DCP-S-029, Chemical Hygiene.

5.14 Incompatibility Between Contents and Metal Parts

PV/S will not be used with a gas or liquid other than what it was designed for without the explicit approval of the Pressure System Manager and the Safety Office.

5.14.1 Generally, PV/S are manufactured and certified to contain either air, a specific gas or liquid or mixtures thereof. If used as certified PV/S do not usually pose an incompatibility hazard when kept within operating limits of pressure and temperature. Incompatibility can cause corrosion, embrittlement, or other chemical reactions that reduce the integrity of the PV/S. Should an incompatibility between the metals, in any part of PV/S, and the materials contained in it occur a failure of the system may result. For questions regarding metal/content incompatibility contact the Industrial Hygienist at the Safety Office

proper 5.14.2 Hydrogen: Hydrogen gas tends to cause embrittlement of certain metals, therefore, special care shall taken to ensure hydrogen gas is stored in containers. Only containers certified for hydrogen will be used at DFRC.

5.15 Color Coding and Labeling of Piping and Tubing

Piping or tubing containing gases or fluids under pressure will be color coded or labeled. If a pipe or tubing in a work area cannot be identified Facilities Maintenance will be called to identify and color code or label it.

6.0 PV/S CONTAINING HAZARDOUS MATERIAL

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Extra precautions shall be when handling or using PV/S that contain hazardous materials. For questions regarding safe handling and use of questionable or known hazardous material contact the Industrial Hygienist at the Safety Office. Two gases that are hazardous and are occasionally used at DFRC are:

6.1 Acetylene

Acetylene is a fuel gas used primarily in welding operations. Care must be taken to ensure acetylene is not stored near oxidizer such as oxygen, (see 6.3 Oxygen).

Acetylene cylinders shall be transferred, handled, stored, and utilized in accordance with Compressed Gas Association Pamphlet G-1 which is incorporated by reference to OSHA regulations.

6.2 Hydrogen

Hydrogen is a highly flammable gas that requires special handling. Precautions required when handling or using either gaseous or liquid hydrogen include:

- The area around the hydrogen container and the container shall be properly vented.
- The location of the hydrogen containers ,depending on their volume, shall meet strict requirements as to distance from oxidizer gases, personnel, electrical equipment, etc.
- Hydrogen storage areas shall be permanently placarded such as "HYDROGEN-FLAMMABLE GAS-NO SMOKING-NO OPEN FLAMES."
- Hydrogen shall not be stored in incompatible containers. (See 5.13.5 Hydrogen.)

For details in the safe handling and utilization of gaseous and liquid hydrogen see 29 CFR 1910.103, Hydrogen.

6.3 Oxygen

Oxygen cylinders in storage will be separated from fuel gas cylinders or combustible materials by a minimum distance of 20 ft or by a barrier of noncombustible material at least 5 ft high, and above the line of sight of the oxygen and fuel cylinders with a fire-resistance rating of at least 30 min.

7.0 RECORDS

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7.1 Using Organizations

A listing of active and inactive PV/S will be maintained by Line Supervisors who control the PV/S. This listing will be made available to the Pressure System Manager on request. DFRC 228, available in this document, will be used for this purpose.

7.2 Pressure System Manager

The Pressure System Manager will maintain a consolidation data base of all PV/S under DFRC control. This information will be made available to authorized persons and HQ. NASA on request.

7.3 Record Disposition

Records will be kept on each PV/S whether active or inactive until the PV/S has been excessed, salvaged, or in other ways removed from DFRC control. Records will then be retired IAW requirements or NPD 1441.1 Records Retention Schedule.

8.0 TRAINING

8.1 Training Requirements

Supervisors who control PV/S shall ensure that employees receive training before operating PV/S. Training shall consist of formal classroom or hands-on training on the system/s that the employee will be operating or working near.

8.2 Training Records

Employee's training records will be maintained by his/her supervisor or in a central location where the records are accessible to the supervisor, employee and authorized inspectors/personnel. Training records will be maintained for five (5) years after the employee terminates or ceases to use the training. (See NPD 1441.1, Records Retention Schedule 3; 33 [3400] N 15-38, G Technical Training.) On-site contractors are responsible for maintaining training records for their employees.

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Quantity	Manufacture & ID Number	Contents: Name of Gas or Liquid	Active? Yes or *No	Capacity/Size	MAWP	Used For?	Last Recert. Date & Due Date	Location/Comments * If Inactive Give Date Unit Became Inactive

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